



Marked-Up Version of Amendments Submitted With
Amendment; Response to Final Office Action Mailed January 2, 2003

2193. (amended) A method of treating a coal formation in situ, comprising:
providing heat from one or more heaters to at least a portion of the formation; ~~and~~
allowing the heat to transfer from one or more of the heaters to a part of the formation
such that a permeability of at least a portion of the part of the formation increases to greater than
about 100 millidarcy; and
controlling a pressure within at least a majority of the part of the formation, wherein the
controlled pressure is at least about 2.0 bar absolute.

2194. (amended) The method of claim 2193, wherein the one or more heaters comprise at least
two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least
some hydrocarbons within the part of the formation.

2201. (amended) The method of claim 2193, further comprising controlling the heat such that
an average heating rate of the part of the formation is less than about 1 °C per day ~~during in a~~
pyrolysis temperature range.

2202. (amended) The method of claim 2193, wherein providing heat from one or more of the
heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the coal formation from one or more- of the heaters,
wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at
least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than
 $h \cdot V \cdot C_v \cdot \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the
selected volume is about 10 °C/day.

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2204. (amended) The method of claim 2193, wherein providing heat from one or more of the heaters ~~comprises heating the part of the formation such that~~ increases a thermal conductivity of at least a portion of the part of the formation ~~is to~~ greater than about 0.5 W/(m °C).

2216. (amended) The method of claim 2193, further comprising producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

2225. (amended) The method of claim 2193, further comprising:
producing hydrogen (H₂) and condensable hydrocarbons from the formation; and
hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

2227. (amended) The method of claim 2193, wherein allowing the heat to transfer ~~comprises increasing~~ increases a permeability of a majority of the part of the formation such that the permeability of the part is substantially uniform.

2232. (amended) A method of treating a coal formation in situ, comprising:
providing heat from one or more heaters to at least a portion of the formation; ~~and~~
allowing the heat to transfer from one or more of the heaters to a part of the formation to increase a permeability of a majority of at least a portion of the part of the formation such that the permeability of the majority of the part is substantially uniform; and
controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range.

2233. (amended) The method of claim 2232, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

2241. (amended) The method of claim 2232, wherein providing heat from one or more of the heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the coal formation from one or more of the heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

2243. (amended) The method of claim 2232, wherein providing heat from one or more of the heaters ~~comprises heating the part of the formation such that~~increases a thermal conductivity of at least a portion of the part of the formation ~~is to~~ greater than about 0.5 W/(m °C).

2255. (amended) The method of claim 2232, further comprising producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

2264. (amended) The method of claim 2232, further comprising:

producing hydrogen (H₂) and condensable hydrocarbons from the formation; and

hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

2265. (amended) The method of claim 2232, wherein allowing the heat to transfer ~~comprises increasing~~increases a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

5081. (amended) A method for treating hydrocarbons in at least a portion of a coal formation, wherein the portion has an average permeability of less than about 10 millidarcy, comprising:

providing heat from one or more heaters to the formation;

allowing the heat to transfer from one or more of the heaters to a part of the formation such that heat from one or more of the heaters pyrolyzes at least some hydrocarbons within the part of the formation, and wherein heat from one or more of the heaters increases the permeability of at least a portion of the part of the formation; ~~and~~

producing a mixture comprising hydrocarbons from the formation;

monitoring a composition of the produced mixture; and

controlling a pressure in at least a portion of the formation to control the composition of the produced mixture.

5082. (amended) The method of claim 5081, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation, and wherein superposition of heat from at least the two heaters increases the permeability of at least the portion of the part of the formation.

5084. (amended) The method of claim 5181, wherein the heat is provided such that an average temperature in the part of the formation ranges from ~~approximately~~ about 270 °C to about 400 °C.

5150. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation;

allowing the heat to transfer from one or more of the heaters to a part of the formation such that a permeability of at least a portion of the part of the formation increases, ~~and is to~~ greater than about 100 millidarcy; ~~and~~

controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day in a pyrolysis temperature range; and

controlling formation conditions to produce a mixture from the formation, wherein a partial pressure of H₂ within the mixture is greater than about 0.5 ~~bars~~ bar absolute.

5151. (amended) The method of claim 5150, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

5156. (amended) The method of claim 5150, wherein providing heat from one or more of the heaters ~~comprises heating the part of the formation such that~~ increases a thermal conductivity of at least a portion of the part of the formation ~~is to~~ greater than about 0.5 W/(m °C).

5167. (amended) The method of claim 5150, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

5172. (amended) The method of claim 5150, wherein allowing the heat to transfer ~~comprises increasing~~ increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform.

5175. (amended) A method of treating a coal formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation;

allowing the heat to transfer from one or more of the heaters to a part of the formation such that a permeability of at least a portion of the part of the formation ~~increases, and is to~~ greater than about 100 millidarcy; ~~and~~

controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute; and

producing a mixture from the formation, wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15.

5179. (amended) The method of claim 5175, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during in a pyrolysis temperature range.

5181. (amended) The method of claim 5175, wherein providing heat from one or more of the heaters ~~comprises heating the part of the formation such that~~increases a thermal conductivity of at least a portion of the part of the formation ~~is to~~ greater than about 0.5 W/(m °C).

5191. (amended) The method of claim 5175, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

5196. (amended) The method of claim 5175, wherein allowing the heat to transfer ~~comprises increasing~~increases a permeability of a majority of the part of the formation such that the permeability of the majority of the part is substantially uniform.

5202. (amended) The method of claim 2193, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~.

5203. (amended) The method of claim 2193, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~ proximate to and/or surrounding at least one of the heaters.

5206. (amended) The method of claim 2232, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~.

5207. (amended) The method of claim 2232, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~ proximate to and/or surrounding at least one of the heaters.

5210. (amended) The method of claim 5081, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~.

5211. (amended) The method of claim 5081, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~ proximate to and/or surrounding at least one of the heaters.

5215. (amended) The method of claim 5150, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~.

5216. (amended) The method of claim 5150, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~ proximate to and/or surrounding at least one of the heaters.

5220. (amended) The method of claim 5175, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~.

5221. (amended) The method of claim 5175, wherein a pyrolysis zone is established in the part of the formation ~~comprises a pyrolysis zone~~ proximate to and/or surrounding at least one of the heaters.